

Experimental Ecosystem Accounting. The experience of Mexico.

Presented by: Raúl Figueroa Díaz^{1,2}

Abstract.

The purpose of this document is to share the experience gained in Mexico during the implementation process of Experimental Ecosystem Accounting (SEEA-EEA-Mx) as part of the pilot countries of the Project of Natural Capital Accounting and Ecosystem Services Assessment lead by UNSD, and that it is coordinated in the country by the National Institute of Statistics and Geography (INEGI).

It is standed out that for national counters and in particular for the environmental ones use of Geographic Information Systems (GIS) is uncommon, so that its use in the national accounting offers less analysis opportunity, requiring a learning process focused in the use of maps and statistics at the same time.

Since the elaboration of the SEEA-CF we have been working with cartographic series and the map of land uses, but more at user's level than information generators, so working in particular with ecosystem accounts demands another sort of requirements. The information demands has evolved giant steps in the last years, which is why tools that allow obtain more and better information must grow up in the same dimension. In this sense, the use of satellite images allows to identify in more detail data that in another way would be impossible to collect with traditional statistics surveys.

The use of Geographic Information Systems is a recurring practice in the world, however, it is necessary to use information that meets certain standards that allows make the different layers of each ecosystem comparable and at different points in time.

In Mexico the homologation includes the use of shapes with projection Albers Equal Area, with scale 1: 250,000, it lets to take advantage of the information generated by different sources of the environmental sector, such as the National Water Commission (map of aquifers), National Commission for the Knowledge and Use of Biodiversity (list of endangered species), National Commission on Natural Protected Areas (EcoValor), among others. These institutions have long developed works that respond to the particular needs and objectives related to the functions of each institution, and which have been taken up in a coordinated and consensual way for the EEA-Mexico project.

On the other hand, the municipal delimitation has been determined as EAU, using information in vector format. It is important to emphasize that, in cases where municipalities have a very small extension, several municipalities have been added based on the regionalizations established in the plans of the state governments. This decision was taken mainly considering that one of the objectives of the EEA-Mexico is that the derived information serves to construct economic, environmental and political indicators. This delimitation seeks to present information to a level that allows knowing, analyzing and making decisions at clear levels of local governance.

Finally, the advances that have been achieved to date are the result of the coordinated work between the institutions that integrate the environmental sector in Mexico and the areas of

¹ National Institute of Statistics and Geography (INEGI). Mexico.

² In order to make this paper we have the invaluable contribution of the following INEGI satellite accounts researchers: J. Federico González Medrano, Diana Enciso Gómez and Cesar Cabrera Cedillo.

geography and statistics within INEGI. An inter-institutional technical working group was created, in which its members have adequate knowledge for the strengthening of the project and of the benefits that they are going to get for their own projects with the information derived of the EEA-Mx.

Introduction

The decision of Mexico to participate as pilot country in the implementation of the System of Environmental-Economic Accounting. Experimental Ecosystem Accounting (SEEA – EEA), is due to in the development of its Environmental Accounting and by having in a same institution, INEGI, the responsibility of development the statistics and official geographical information. It is considerate that EEA-Mx is able to be a tool to register the physical features (extent and condition) of existing ecosystems inside national and subnational limits, in several points in the time, it display changes occasioned as the result of the interaction between economy and the being human in general. For this is important to value the several ecosystem services that flows towards the economy and other human activities of each ecosystem registered. The results will allow to obtain economic, social and environmental indicators that can generating and/or strengthening of several public politics.

The analysis proposed in the SEEA-EEA allow development projects concurrently, linking another sectors in a close relationship with the environmental border, such as the measuring sustainable tourism, for that it is developing a methodological proposal through the measure of ecosystem services in the Natural Protected Areas (NPA) with a touristic influence, whom can be marked and valuated economically. These purposes are designed to generate an overall picture and considerate to a larger extent environmental outlook of these sites. This is showing in more detail in the second part of this paper.

Technical background

The SEEA-EEA manual as much as Technical Guides recommend the use of Geographic Information Systems as a tool for the generation and processing information of national character; due to the facility this kind of software give for the management of big data sets through geographically referenced thematic layers (known as “shapefiles”), which are graphical representations of features of territory in scale.

In this context, although the use of GIS is a common practice among biologist and geographers, it is understand the relevance that economist and national entities in general take advantage of this tools to build National Accounts and the Environment Accounting.

Considering the complexity of the use of geographical tools, our assimilation process of the GIS's kindness consisted, in a first phase, in the use of a tool developed by INEGI, called “Mapa Digital de México”, which allows in a very friendly way integrate environmental and cultural information about the geographic environment of the country and link it with statistics data. Furthermore of being an intuitive platform for the users that are inexperienced in this systems, it creates a basis to move on to more sophisticated tool such as ArcGis. Aware of the need to take the most advantage of the technical potential that allow the construction of the Ecosystems Accounts, it has been created a basic guide for inexperienced user with GIS, showing in a schematic way how to use in a few instructions the software of Mapa Digital de México, loading shapes of information of use of soil, water, grasslands, among another more.

The correct use of shapefiles needs to meet with standards that let to make a correct comparison among them. Firstly is necessary to define the kind of layer to use based on our

needs, in other words, the type of format of the shapefile, which can be raster or vector. In the SEEA-EEA manual is recommended the use of raster format, but in Mexico we identified some drawbacks that are showed below:

- They are made up of pixels, which the smaller ones are more detailed, and at the same time generate heavier files and therefore make difficult their processing in GIS.
- When delineating these pixels with some polygon, the calculated area has discrepancies with the real areas because its delimitation is usually rough, which makes it difficult to draw polygons with curves and as a result generates losses and / or gains from areas where it does not correspond.

In contrast, files in vector format are lighter, which encourage the processing of big layers (such as nationally); allow more stylized and fine strokes, so the calculation of areas is able to be more accurate compared to raster files.

Once the types of files to be used have been defined, it is also important to select the scale, considering the availability of information in the country. During the development of the project, some needs were detected in the cartographic information available for use in Geographic Information Systems, because there were layers of information on several topics but at different scales. In our case, it was determined that the appropriate scale for the development of cartographic information in the area of ecosystem extension should be the 1: 250,000 scale. This scale is useful for the visualization of information at the state and national level, since it grants an overview of the territory but not so detailed, but coincides with the intention that this project is a first approach to the accounting of ecosystem services in the countries.

Another important feature of the layers is their projection. This feature refers to the necessity of maintain the areas (equivalent), forms (conform) or distances (equidistant) through mathematical methods which let us see the environmental from one of those approaches, because it is impossible to have a projection that maintain all those approaches at the same time. So, it was determined that for the project the best option was the use of the Albers Equal Area projection in all the cartography, which, according with its name, maintains the areas of the polygons that is very important in the case of the extent account.

All the information is nationally, and for its treatment was necessary to delimitate the study areas, that is the reason EAU were municipalities. At the same time, it was defined the use of regions in the states that have more than 17 municipalities or in municipalities that represents a very small proportion of total state extent, because Mexico has 2,457 municipalities and the individual treatment of all of them would be harder. For example, the state of Oaxaca has only 570 municipalities. As a result of this in 26 states were made sets in regions, according with the official administrative regionalizations established in State Government Plans, generating information on a scale where changes are best appreciated graphically and encourage the generation of social and political type indicators by including aspects of governance. In the case of five states, it was decided to leave the classification in municipalities because of its extent, it is possible to identify more easily the differences between the several ecosystems. A particular case is Mexico City, due to it is a very small area comparison with the total of the national extent, and is further divided into 16 political delegations, which did not allow adequate visualization of the changes. Consequently this entity was studied in its entirety as a single EAU without political divisions.

These experiences are derived from the work of an interagency group, made up of several entities from the Mexican environmental sector such as the Ministry of the Environment and Natural Resources (SEMARNAT), the National Commission for the Knowledge and Use of Biodiversity (CONABIO), the National Commission for Protected Areas (CONANP), the National Forestry Commission (CONAFOR), the National Water Commission (CONAGUA) and the National Institute of Ecology and Climate Change (INECC); academic institutions such as the National Autonomous University of Mexico and the College of Hidalgo; in addition to international organizations such as the German International Cooperation (GIZ) and the Biodiversity Finance Project (BIOFIN).

As a result of this working group, the ecosystem extent account has been developed for all Mexican states and their respective municipalities or regions. This account allows to know the coverage of the ecosystems at different points in time, and consequently, the changes occurred in the extent of the ecosystems. INEGI has developed five series of thematic layers of Land Use and Vegetation, from those we have been considered the information of the III and V series for the development of the project, due to its characteristics and moments in time to which they refer. In addition, since the serie I have been generating improvements in the generation of the cartographic information, reason why the data in the most recent series is more accurate.

Among the attributes of these layers there is information that refers to the sorts of vegetation in the country, according to the classification of the Catalog of Kinds of Natural and Induced Vegetation of Mexico, as well as information based on the successional phases associated with the type of vegetation: primary, secondary, induced, indefinite or without apparent vegetation. In addition, the correlation of the layers was made to make them comparable with the classification proposed in SEEA-EEA, which is based on the FAO Land Classification System version 3 (LCCS 3). In this way, faster processing of information was achieved and the extraction of more complex databases was allowed.

Once the extent account has been developed, the ecosystem condition accounts are constructed, which let us know the state of the ecosystems. This account is the instrument to record the quality of ecosystem services through the measurement of degradation, so it is important to have data for a first point in time. In the case of the EEA-Mx, data from the serie III of the Land Use and Vegetation Layer was taken, and from this information a baseline is maintained that allows, ultimately, the design of public policies that seek conservation and care of ecosystems.

This account is addressed in a differentiated way through four priority components for ecosystems: soil, carbon, water and biodiversity. This set of accounts uses biophysical information on the condition of priority components by means of variables such as: soil type, soil erosion, successional vegetation cover, surface and ground water quality, species richness, abundance of species and endemic species.

The Tables of Supply and Use represent the last set of tables in physical units that is presented in the Ecosystem Accounts. These tables show the origin of the different ecosystem services and their final destination within the economy and other human activities. It is considered important to always present a balance in the results, since the

services reflected in these output tables are those that have a specific demand, ie if there is no demand there would be no supply within the spectrum of anthropogenic activities³.

Finally, SEEA-EEA argues that in the context of comparing values of ecosystem services with those recorded in national accounts, the objective is to assess the amount of ecosystem services at market prices that would have existed if they were traded and traded freely (SEEA-EEA, 5.20). Thus, where an ecosystem service is linked to the value of the production of a good in the SNA, valuation approaches should focus on determining the contribution of the ecosystem service to the market price of the product in question, plus than in the assessment of ecosystem service directly (SEEA-EEA, 5.57).

In this sense, in the EEA-Mx, two valuation exercises have been developed so far, on the one hand, with the minimum costs that would have to be used to compensate for soil erosion (remediation costs) and, on the other hand, other side, with the costs of maintaining or increasing the carbon stock in the soil (social cost).

Experience gained

The development of the EEA-Mx project has been a process of implementation of previous knowledge but above all of learning. Today more than ever we are sure that it is not possible to work individually, and that intra and interinstitutional work are necessary for the achievement of the stated objectives. This type of interaction facilitates the exchange of information, and ensures that all the institutions involved know step by step the progress that is being made and that they give their opinion and contribute to the process in a timely manner.

In this way, the EEA-Mx agreed to use the country-specific threatened species list, published in Official Mexican Standard NOM-059-SEMARNAT-2010⁴, instead of the Red List suggested in the SEEA-EEA manual.

Another agreement reached within the Technical Working Group was the homologation of the cartographic projection using Albers Equal Area for the whole country, in addition to the use of the same scale (1: 250,000)⁵ for all geographic charts.

The SEEA-EEA suggests the use of inputs in raster format, however considering that the technological advance has evolved and that it is most appropriate to seek international comparison, it was decided to use the vector format.

On the other hand, it was decided that the minimum unit of study will be the municipality, being consistent with the minimum unit of Government, which would be useful to elaborate specific indicators of social, economic and environmental type.

In addition, a tutorial was developed for the elaboration of extension accounts based on Mapa Digital de México, which seeks to enable the basic use of GIS tools to users who are not specialists in the subject.

³ It is important to clarify that in ecosystem processes there are exchanges of services that occur without the intervention of the human being, however in the Ecosystems Accounts are registered those services used and / or affected by the economy and other human activities.

⁴ <http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/DOFs/DO2454.pdf>

⁵ In particular cases and when necessary, a higher resolution will be used, as long as the cartographic information exists.

Finally, there is a website for the members of the Technical Working Group which contains bibliography, reports of the group meetings, contact information of the group members, information of upcoming events, among other information.

The importance of implementing the SEEA-EEA recommendations from a national perspective has allowed the involved entities to take advantage of the process and contemplate the use of the derived results in the construction or strengthening of their institutional projects.

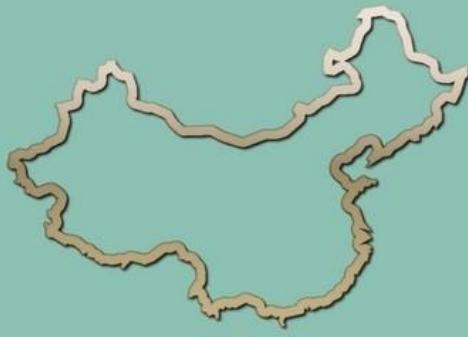
EXPERIMENTAL ECOSYSTEM ACCOUNTS



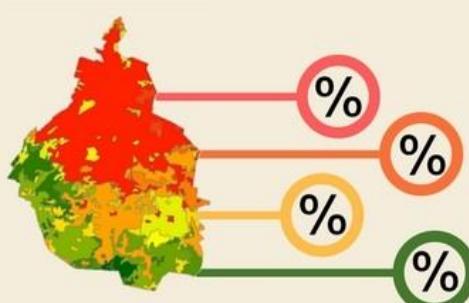
OBJECTIVE: Record ecosystem services for the economy and other human activities

GEOSPATIAL INFORMATION

- The shapefiles are obtained at the national level
- Cartographic approval (projection)
- Generation of shapefiles at regional level by theme



STATISTICAL DATA COLLECTION



- Calculation of areas by attributes of ecosystems
- Metadata extraction
- Organization and grouping of information

EXTENSION ACCOUNTS

- Extension by municipality / region and by type of ecosystem
- Balance generation
- Generation of change matrices



SUPPLY AND USE TABLES

- Origin and destination of ecosystem services

CONDITION ACCOUNTS

Priority components:

- Erosion of soil
- Carbon
- Water
- Biodiversity



ECONOMIC VALUATION

- Soil erosion (remediation costs)
- Carbon in soil (social cost)